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(54) **Organic electroluminescent display device and method for manufacturing the same**

Organische elektrolumineszente Anzeigevorrichtung und Herstellungsverfahren

Dispositif d'affichage électroluminescent organique et méthode de fabrication

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- **PATENT ABSTRACTS OF JAPAN vol. 015, no. 295 (E-1094), 26 July 1991 (1991-07-26) -& JP 03 105893 A (FUJI ELECTRIC CO LTD), 2 May 1991 (1991-05-02)**
- **PATENT ABSTRACTS OF JAPAN vol. 2003, no. 05, 12 May 2003 (2003-05-12) -& JP 2003 022035 A (SHARP CORP), 24 January 2003 (2003-01-24)**

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an organic electroluminescent display device and method for manufacturing the same. More particularly, the invention is directed to an organic electroluminescent display device and method for fabricating the same, in which corners of a lower (pixel) electrode are rounded off, thereby preventing contamination caused by outgassing and short-induced defects.

2. Description of the Related Art

[0002] With the development of active matrix organic light emitting devices (AMOLED) into flat panel display devices using organic electroluminescence devices (OELDs) and with application of AMOLEDs to mobile phones, great reduction in thickness, size and fabricating cost have been achieved.

[0003] FIG. 1A shows a planar structure of a conventional AMOLED having two transistors and a capacitor. FIG. 1B is a cross-sectional view taken along the line I-I of FIG. 1A.

[0004] Referring to FIG. 1B, the conventional AMOLED includes an emission region 110 and a non emission region 130. In the emission region 110, a lower electrode 131 (e.g., a pixel electrode), an organic emission layer 132 and an upper electrode 133 are formed. In the non-emission region 130 two thin film transistors (TFTs) and a capacitor are formed.

[0005] A buffer layer 140 is formed on a transparent insulating substrate 100 such as a glass substrate, and an amorphous silicon layer is deposited on the buffer layer to form a semiconductor layer 111. The semiconductor layer 111 is formed by performing a crystallization process after patterning the deposited amorphous silicon layer. Then, a gate insulating layer 150 is formed on the entire surface of the substrate. Thereafter, a metallic material for a gate electrode is deposited and patterned on the gate insulating layer 150 to form a gate 112 on the semiconductor layer 111. Additionally, a capacitor lower electrode 122 is simultaneously formed at this time. Upon formation of the gate 112 and the capacitor lower electrode 122, a gate line 102 of FIG. 1A is also formed.

[0006] Thereafter, source/drain regions 113 and 114 are formed by ion implantation of, for example, P or N type impurities, into the semiconductor layer 111.

[0007] Next, an interlayer insulating layer 160 is formed on the entire surface of the substrate. Then the interlayer insulating layer 160 and the gate insulating layer 150 are etched to expose portions of the source/drain regions 113 and 114, thereby forming contact holes 161 and 162 for source/drain electrodes.

[0008] Then, after a metallic material for the source/drain electrodes is deposited on the interlayer insulating layer 160, the source/drain electrodes 115 and 116 are formed to contact with the source/drain regions 113 and 114 through the contact holes 161 and 162. Then a capacitor upper electrode 126 is formed which extends from any one electrode, for example, the source electrode 115, of the source/drain electrodes 115 and 116; at the same time, a data line 104 and a power line 106 of FIG. 1A are also formed.

[0009] Thereafter, a passivation layer 170 is formed on the interlayer insulating layer 160. The passivation layer 170 is etched as to expose a portion of the other electrode, for example, the drain electrode 116, of the source/drain electrodes 115 and 116, thus forming a contact hole 171 for a pixel electrode.

[0010] Then, a transparent conductive layer is deposited on the passivation layer 170 and is patterned to form the lower electrode 131 contacting with the drain electrode 116 through the contact hole 171 for pixel electrode in the emission region 110.

[0011] After an insulating layer 180 is formed on the passivation layer 170, an opening 181 is formed to expose the lower electrode 131. An organic emission layer 132 is formed on a planarization layer 180 including the opening 181, and an upper electrode 133 is formed thereon.

[0012] In the conventional OLED, although the insulating layer 180 is similar to a pixel definition layer (PDL) defining the emission region, the PDL is commonly formed of an organic layer. However, a problem arises in that the organic emission layer 132 becomes contaminated due to outgassing. To address this problem, an organic light emitting display device may be formed without such pixel definition layer. However, another problem often experienced in conventional OLEDs formed without pixel definition layers is short-induced defects that generate a dark spot in their corresponding pixels.

[0013] For example, FIG. 2A shows an embodiment of the planar structure of an organic light emitting display device without a pixel definition layer, and FIG. 2B is a cross-sectional view taken along the line II-II of FIG. 2A.

[0014] A method for manufacturing the organic light emitting display device without such pixel definition layer is now explained with reference to FIGS. 2A and 2B.

[0015] Referring to FIGS. 2A and 2B, a thin film transistor and a capacitor are formed on a non emission region 220 in the same manner and structure as illustrated in FIGS. 1A and 1B. Then, a lower electrode 261 is formed by depositing a transparent conductive layer in the emission region on the entire surface of a substrate so as to contact a source/drain electrode formed in the non-emission region through a contact hole 258 for pixel electrode and H patterning the same.

[0016] Now, steps for forming the lower electrode 261 are illustrated through FIGS. 2C to 2E. FIG. 2C is a perspective view showing the steps for forming the lower electrode 261, FIG. 2D is a plan view of the lower electrode 261, and FIG. 2E is a cross-sectional view taken along the line III-III of FIG. 2D.

[0017] Referring to FIGS. 2C to 2E, corners of upper and lower portions of the lower electrode 261 are formed in an angle shape. As shown in FIG. 2E, a length L2 of the lower portion of the lower electrode 261 is formed longer than a length L1 of the upper portion of the lower electrode 261. That is, the lower electrode 261 has a side slanted at a tapered angle.

[0018] An organic emission layer 262 is formed on the lower electrode 261. Then an upper electrode 263 made of a metallic material is formed on the organic emission layer.

[0019] Upon the formation of the organic emission layer 262 on the lower electrode 261, a step is formed. However, in use, a short-induced defect may be generated due to an open edge phenomenon. Thus, in the case where the upper and lower portions of the transparent conductive layer are angled, the organic emission layer 262 often deteriorates at its corner portion to expose the lower electrode 261.

[0020] To address this problem, embodiments of the invention provide a lower pixel electrode having rounded corners.

[0021] Illustratively, FIG. 2F shows an enlarged view of an emission region upon the generation of a short-induced defect.

Further embodiments of conventional organic electroluminescent display devices are shown in the following documents:

EP1333497 (A2) teaches an organic electroluminescent display device, comprising a thin film transistor formed in a non-emission region on an insulating substrate and having source and drain electrodes; a lower electrode formed in an emission region on the insulating substrate and connected to one electrode of the source and drain electrodes through a contact hole; an organic emission layer formed in the emission region on the lower electrode; and an upper electrode formed on the organic emission layer,

JP3105893 (A) discloses a thin film electroluminescent device having etched sharp parts of the surface of a transparent electrode and rounded the corner parts. The sharp projected parts in the corners of the transparent electrodes form a step on the substrate.

US2003203527 (A1) discloses an active matrix OLED device, having an anode connected to the drain electrode of the TFT through a contact hole, an organic electroluminescent layer covering the anode electrode, and a cathode on the organic electroluminiscent layer.

JP 2001 110575 A discloses an organic electroluminescent display device, comprising a lower electrode connected to the source of the TFT, whereby the side faces of the anode have a tapered incline that becomes broader to a lower layer.

SUMMARY OF THE INVENTION

[0022] The present invention is directed to an improved organic electroluminescent display device that has no pixel definition layer. Embodiments of the present invention also provide a method for fabricating the same, which prevents outgassing and short-induced defects by forming a lower (e.g. pixel) electrode having corners that are rounded off.

[0023] In one embodiment, an organic electroluminescent display device includes a thin film transistor formed in a non-emission region on an insulating substrate, which includes source/drain electrodes. The organic electroluminescent display device further includes a lower electrode formed in an emission region on the insulating substrate and connected to one electrode of the source/drain electrodes through a contact hole. It also includes an organic emission layer formed in the emission region on the lower electrode, and an upper electrode formed on the organic emission layer, wherein the lower electrode has a surface with its corners rounded off.

In a first alternative of that embodiment, the lower electrode has an upper surface in which a center of radius of curvature is at its corners so that the radius of curvature is zero, and a lower surface whose corners have curvature in which a center of radius of each curvature is at a point on the same axis as an axis on which a center of radius of curvature of the upper surface is positioned, wherein the axis is perpendicular to a plane on which the center of radius of each curvature of the upper surface is positioned so that the radius of each curvature of the lower surface is larger than zero.

In a second alternative of that embodiment, the lower electrode has an upper surface whose corners have curvature whose center is positioned on the upper surface, and a lower surface whose corners have curvature in which a center of radius of each curvature is at a point on the same axis as an axis on which a center of radius of curvature of the upper surface is positioned, wherein the axis is perpendicular to a plane including the center of the radius of each curvature of the upper surface, wherein the radius of each curvature of the lower surface is larger than that of the upper surface.

[0024] Preferably, the upper and the lower surface of the lower electrode has four corners and wherein in the first alternative curvature is formed at all four corners of the lower surface, respectively, and wherein in the second alternative curvature is formed at all four corners of the upper and lower surfaces, respectively.

In one embodiment, the upper electrode is a cathode electrode and the lower electrode is an

[0025] Another aspect of the present invention provides a method for manufacturing an organic electroluminescent display device. A thin film transistor having source/drain electrodes is formed in a non-emission region on an insulating substrate. A lower electrode is formed in an emission region on the insulating substrate and connected to one electrode of the source/drain electrodes through a contact hole. The lower electrode has rounded corners. An organic emission layer is formed in the emission region on the lower electrode. An upper electrode is formed on the organic emission layer.

In a first alternative, the lower electrode has an upper surface in which a center of radius of curvature is at its corners so that the radius of curvature is zero, and a lower surface whose corners have curvature in which a center of radius of each curvature is at a point on the same axis as an axis on which a center of radius of curvature of the upper surface is positioned, wherein the axis is perpendicular to a plane on which the center of radius of each curvature of the upper surface is positioned so that the radius of each curvature of the lower surface is larger than zero.

In a second alternative, the lower electrode has an upper surface whose corners have curvature whose center is positioned on the upper surface, and a lower surface whose corners have curvature in which a center of radius of each curvature is at a point on the same axis as an axis on which a center of radius of curvature of the upper surface is positioned, wherein the axis is perpendicular to a plane including the center of the radius of each curvature of the upper surface, wherein the radius of each curvature of the lower surface is larger than that of the upper surface.

[0026] Preferably, the upper and the lower surface of the lower electrode has four corners, wherein in the first alternative curvature is formed at all four corners of the lower surface, respectively, and in the second alternative curvature is formed at all four corners of the upper and lower surfaces, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] FIG. 1A shows a planar structure of a conventional AMOLED;

[0028] FIG. 1B is a cross-sectional view taken along the line I-I of FIG. 1A;

[0029] FIG. 2A shows a planar structure of another conventional organic electroluminescent display device;

[0030] FIG. 2B is a cross-sectional view taken along the line II-II of FIG. 2A;

[0031] FIG. 2C is a perspective view showing steps for forming the lower electrode of FIG. 2A;

[0032] FIG. 2D is a plan view of the lower electrode of FIG. 2C;

[0033] FIG. 2E is a cross-sectional view taken along the line III-III of FIG. 2D;

[0034] FIG. 2F is an enlarged photograph of the emission region upon generation of the short-induced defect;

[0035] FIG. 3A shows a planar structure of an organic electroluminescent display device according to a first embodiment of the present invention;

[0036] FIG. 3B is a cross-sectional view taken along the line IV-IV of FIG. 3A;

[0037] FIG. 3C is a perspective view showing steps for forming the lower electrode of FIG. 3A;

[0038] FIG. 3D is a plan view of the lower electrode of FIG. 3C;

[0039] FIG. 3E is a cross-sectional view taken along the line V-V of FIG. 3D;

[0040] FIG. 4A shows a planar structure of an organic electroluminescent display device according to a second embodiment of the present invention;

[0041] FIG. 4B is a perspective view showing steps for forming the lower electrode of FIG. 4A;

[0042] FIG. 4C is a plan view of the lower electrode of FIG. 4A; and

[0043] FIG. 4D is a cross-sectional view taken along the line VII-VII of FIG. 4C.

DETAILED DESCRIPTION OF THE INVENTION

[0044] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout the specification.

[0045] FIG. 3A shows a planar structure of an active matrix organic electroluminescent display device (AMOLED) according to a first embodiment of the present invention. The AMOLED of FIG. 3A illustrates a device consisting of two transistors and a capacitor.

[0046] FIG. 3B shows a cross-sectional view taken along the line IV-IV of FIG. 3A.

[0047] Referring to FIG. 3B, in an AMOLED formed according to one embodiment of the present invention, a buffer layer 340 is formed on a transparent insulating substrate 300, such as a glass substrate. The substrate includes a non-emission region 310 and an emission region 330. Then, an amorphous silicon layer is deposited on the buffer layer 340 to form a semiconductor layer 311. The semiconductor layer 311 is formed by performing a crystallization process after patterning the amorphous silicon layer. Then, a gate insulating layer 350 is formed on the entire surface of the substrate, and a metallic material for a gate electrode is deposited and patterned on the gate insulating layer 350 to form a gate 312 over the semiconductor layer 311. A capacitor lower electrode 322 is simultaneously formed at this time. Now, upon the formation of the gate 312 and the capacitor lower electrode 322, a gate line 302 of FIG. 3A is also formed.

[0048] Thereafter, source/drain regions 313 and 314 are formed by ion implantation of, for example, P or N type impurities, into the semiconductor layer 311.

[0049] Next, an interlayer insulating layer 360 is formed on the entire surface of the substrate, and the interlayer insulating layer 360 and the gate insulating layer 350 are etched to expose a portion of the source/drain regions 313 and 314. Thereby, contact holes 361 and 362 for source/drain electrodes are formed.

[0050] Then, after a metallic material for the source/

drain electrodes is deposited on the interlayer insulating layer 360, the source/drain electrodes 315 and 316 are formed to contact with the source/drain regions 313 and 314 through the contact holes 361 and 362. Here, a capacitor upper electrode 326 is formed which extends from any one electrode, for example, the source electrode 315, of the source/drain electrodes 315 and 316. At the same time, a data line 304 and a power line 306 of FIG. 3A are also formed.

[0051] Thereafter, a passivation layer 370 is formed on the interlayer insulating layer 360. The passivation layer 370 is etched to expose a portion of the other electrode, for example, the drain electrode 316, of the source/drain electrodes 315 and 316, thus forming a contact hole 371 for a pixel electrode.

[0052] Then, a transparent conductive layer is deposited on the passivation layer 370 in an emission region 330, and is patterned to form a lower electrode 331 contacting with the drain electrode 316 through the contact hole 371 for the pixel electrode.

[0053] Now, steps for forming the lower electrode 331 of FIG. 3A are illustrated through FIGS. 3C to 3E.

[0054] FIG. 3C is a perspective view showing a whole shape of the lower electrode 331, FIG. 3D is a plan view of the lower electrode 331, and FIG. 3E is a cross-sectional view taken along the line V-V of FIG. 3D.

[0055] As shown in FIGS. 3C to 3E, it can be understood that the upper surface 331 a of the lower electrode 331 has a rectangular shape, and a lower surface 331b of the lower electrode 331 has rounded corners, so that the lower electrode 331 is tapered.

[0056] This can be expressed as following equation.

31 = 0,32>0

[0057] Here, 31 is the radius of curvature of the upper surface 331 a, and 32 is the radius of curvature of the lower surface 331b. The lower electrode 331 has the upper surface 331 a in which the center of the radius of curvature 31 is at its corners so that the radius of curvature is zero. Meanwhile, the center of the radius of each curvature 32 of the lower surface 331b is located at a point on the same axis as an axis on which a center of radius of curvature of the upper surface is positioned, wherein the axis is perpendicular to a plane on which the center of the radius of each curvature of the upper surface 331 a is positioned so that the radius of each curvature 32 is larger than zero. Thus, upper surface 331 a has four angled corners and the lower surface 331b has four rounded corners. Accordingly, since the four corners of the lower surface of the lower electrode 331 are not angled, an open edge defect due to cut-off of the organic emission layer 332 can be prevented even after the organic emission layer 332 is deposited.

[0058] Next, an organic emission layer 332 is formed on the passivation layer 370 including the lower electrode 331. Thereafter, an upper electrode 333 made of a metallic material is formed thereon, thereby creating the active matrix organic electroluminescent display device.

[0059] In the embodiment just described, the lower electrode acts as an anode electrode and the upper electrode acts as a cathode electrode.

[0060] FIG. 4A shows a planar structure of an active matrix organic electroluminescent display device (AMOLED) according to a second embodiment of the present invention. The AMOLED of FIG. 4A illustrates a device having two transistors and a capacitor.

[0061] A cross-sectional view taken along the line VI-VI of FIG. 4B illustrates structure similar to that shown in FIG. 3B. Additionally, a method of manufacturing the second embodiment of the present invention will be easily understood by a person skilled in the art with reference to the above description given with regard to the first embodiment. Thus, FIG. 4A need not be described in detail.

[0062] However, the steps of an exemplary method for forming the lower electrode 431 of FIG. 4A are explained with reference to FIGS. 4B to 4D.

[0063] FIG. 4B is a perspective view showing a whole shape of the lower electrode 431, FIG. 4C is a plan view of the lower electrode 431, and FIG. 4D is a cross-sectional view taken along the line VII-VII of FIG. 4C.

[0064] Upon the formation of the lower electrode 431, shown in FIG. 4C, four corners of an inner portion of an upper surface 431a are rounded on a plane, four corners of an outer portion of a lower surface 431b are rounded. As shown in FIG. 4D, the lower electrode is formed to be tapered so that the lower surface 431 b is formed wider than upper surface 431 a.

[0065] This can be expressed as following equation.

42>0, 41>0

[0066] Here, 41 is the radius of curvature of the upper surface 431 a of the lower electrode 431, and 42 is the radius of curvature of the lower surface 431b of the lower electrode 431.

[0067] The lower electrode 431 has the upper surface 431a whose four corners each have curvature and the center of the curvature is positioned on the upper surface 431a. The center of the radius of curvature 42 of the lower surface 431b is at a point on the same axis as an axis on which a center of radius of curvature of the upper surface is positioned, wherein the axis is perpendicular to a plane including the center of the radius f each curvature 41 of the upper surface 431a, wherein the radius of each curvature 42 of the lower surface 431 b is larger than that of the upper surface 431a, and the four corners of the lower surface 431b are also rounded. Thus, four corners of the upper surface 431a and the lower surface 431b as well of the lower electrode are rounded, so that an open edge defect due to cut-off of the organic emission layer (see 332 of FIG. 3B) is further prevented even after the organic emission layer is deposited.

[0068] The upper electrode (see 333 of FIG. 3B) is formed on the organic emission layer (332 of FIG. 3B) to supply a common power source.

[0069] In this embodiment, the lower electrode 431 is an anode electrode and the upper electrode formed on the organic emission layer is a cathode electrode.

[0070] Although several embodiments of the present invention have been described above, curvature of the lower electrode may also be provided at a side portion so that a shape of the surface of the lower electrode forms an oval or circular shape.

[0071] According to the embodiment of the present invention as described above, in manufacturing an AMOLED having no pixel definition layer, the lower electrode is formed of a transparent metallic material and has the corners of its upper and lower surfaces rounded off, to prevent outgassing and short-induced defects. Such a configuration improves luminosity and increases the life of the organic electroluminescent display device.

Claims

1. An organic electroluminescent display device, comprising:

   a thin film transistor formed in a non-emission region (310) on an insulating substrate (300) and having source and drain electrodes (315, 316);
   a lower electrode (331) formed in an emission region (330) on the insulating substrate (300) and connected to one electrode of the source and drain electrodes (315, 316) through a contact hole (371);
   an organic emission layer (332) formed in the emission region (330) on the lower electrode (331); and
   an upper electrode (333) formed on the organic emission layer (332),
   wherein the lower electrode (331) has a surface with its corners rounded off,
   characterized in that

   (i) the lower electrode (331) has an upper surface (331a) in which a center of radius of curvature (p31) is at its corners so that the radius of curvature (p31) is zero, and a lower surface (331b) whose corners have curvature in which a center of radius of each curvature (p32) is at a point on the same axis as an axis on which a center of radius of curvature (p31) of the upper surface is positioned, wherein the axis is perpendicular to a plane on which the center of radius of each curvature (p31) of the upper surface is positioned so that the radius of each curvature (p32) of the lower surface (331b) is larger than zero or
   (ii) the lower electrode (431) has an upper surface (431 a) whose corners have curvature whose center is positioned on the upper surface (431 a), and a lower surface (431b) whose corners have curvature in which a center of radius of each curvature (p42) is at a point on the same axis as an axis on which a center of radius of curvature (p41) of the upper surface (431a) is positioned, wherein the axis is perpendicular to a plane including the center of the radius of each curvature (p41) of the upper surface (431a), wherein the radius of each curvature (p42) of the lower surface (431b) is larger than that of the upper surface (431 a).

2. The organic electroluminescent display device as claimed in claim 1, wherein the upper and the lower surface (331a; 331b; 431a; 431b) of the lower electrode (331, 431) has four corners and wherein in alternative (i) curvature is formed at all four corners of the lower surface (331b), respectively, and wherein in alternative (ii) curvature is formed at all four corners of the upper and lower surfaces (431a; 431b), respectively.

3. The organic electroluminescent display device as claimed in alternative (i) of claim 1, wherein the upper electrode (333) acts as a cathode electrode and the lower electrode (331; 431) acts as an anode electrode.

4. A method for manufacturing an organic electroluminescent display device, the method comprising the steps of:

   forming a thin film transistor having source/drain electrodes (315, 316) in a non-emission region (310) on an insulating substrate (300);
   forming a lower electrode (331) in an emission region (330) on the insulating substrate (300) to be connected to one electrode of the source/drain electrodes (315, 316) through a contact hole (371), wherein the lower electrode has rounded corners;
   forming an organic emission layer (332) in the emission region (330) on the lower electrode (331); and
   forming an upper electrode on the organic emission layer (332),
   characterized in that

   (i) the lower electrode (331) has an upper surface (331a) in which a center of radius of curvature (p31) is at its corners so that the radius of curvature (p31) is zero, and a lower surface (331b) whose corners have curvature in which a center of radius of each curvature (p32) is at a point on the same axis as an axis on which a center of radius of curvature (p31) of the upper surface is positioned, wherein the axis is perpendicular to a plane on which the center of radius of each curvature (p31) of the upper surface is positioned so that the radius of each curvature (p32) of the lower surface (33 1b) is larger than zero or

(ii) the lower electrode (431) has an upper surface (43 1a) whose corners have curvature whose center is positioned on the upper surface (431a), and a lower surface (431b) whose corners have curvature in which a center of radius of each curvature (p42) is at a point on the same axis as an axis on which a center of radius of curvature (p41) of the upper surface (431a) is positioned, wherein the axis is perpendicular to a plane including the center of the radius of each curvature (p41) of the upper surface (431a), wherein the radius of each curvature (p42) of the lower surface (431b) is larger than that of the upper surface (431a).

5. The method as claimed in claim 4, wherein the upper and the lower surface (33 1a; 331b; 431a; 431b) of the lower electrode (331, 431) has four corners and wherein in alternative (i) curvature is formed at all four corners of the lower surface (331b), respectively, and wherein in alternative (ii) curvature is formed at all four corners of the upper and lower surfaces (431a; 431b), respectively.

Patentansprüche

1. Organische elektrolumineszente Anzeigevorrichtung, aufweisend:

einen Dünnfilmtransistor, der in einer Nicht-Emissionsregion (310) auf einem Isoliersubstrat (300) ausgebildet ist und eine Source-Elektrode und eine Drain-Elektrode (315, 316) aufweist;
eine untere Elektrode (331), die in einer Emissionsregion (330) auf dem Isoliersubstrat (300) ausgebildet ist und über ein Kontaktloch (317) mit einer Elektrode der Source-Elektrode und der Drain-Elektrode (315, 316) verbunden ist;
eine organische Emissionsschicht (332), die in der Emissionsregion (330) auf der unteren Elektrode (331) ausgebildet ist; und
eine obere Elektrode (333), die auf der organischen Emissionsschicht (332) ausgebildet ist,
wobei die untere Elektrode (331) eine Oberfläche aufweist, deren Ecken abgerundet sind,

dadurch gekennzeichnet, dass

(i) die untere Elektrode (331) eine Oberseite (331a), bei der ein Mittelpunkt des Radius der Krümmung (p31) an ihren Ecken ist, sodass der Radius der Krümmung (p31) Null beträgt, und eine Unterseite (331b) aufweist, deren Ecken eine Krümmung aufweisen und bei der ein Mittelpunkt des Radius jeder Krümmung (p32) auf einem Punkt auf der selben Achse liegt wie eine Achse, auf der ein Mittelpunkt des Radius der Krümmung (p31) der Oberseite positioniert ist, wobei die Achse perpendikulär zu einer Ebene ist, auf der der Mittelpunkt des Radius jeder Krümmung (p31) der Oberseite derart positioniert ist, dass der Radius jeder Krümmung (p32) der Unterseite (331b) größer als Null ist, oder

(ii) die untere Elektrode (431) eine Oberseite (431a), deren Ecken eine Krümmung aufweisen, deren Mittelpunkt auf der Oberseite (431a) positioniert ist, und eine Unterseite (431b) aufweist, deren Ecken eine Krümmung aufweisen und bei der ein Mittelpunkt des Radius jeder Krümmung (p42) auf einem Punkt auf der selben Achse liegt wie eine Achse, auf der ein Mittelpunkt des Radius der Krümmung (p41) der Oberseite (431a) positioniert ist, wobei die Achse perpendikulär zu einer Ebene ist, die der Mittelpunkt des Radius jeder Krümmung (p41) der Oberseite (431a) aufweist, wobei der Radius jeder Krümmung (p42) der Unterseite (431 b) größer als derjenige der Oberseite (431 a) ist.

2. Organische elektrolumineszente Anzeigevorrichtung nach Anspruch 1, wobei die Ober- und die Unterseite (331 a; 331 b; 431 a; 431 b) der unteren Elektrode (331, 431) vier Ecken aufweist und wobei gemäß Alternative (i) die Krümmung jeweils an allen vier Ecken der Unterseite (331b) ausgebildet ist, und wobei gemäß Alternative (ii) die Krümmung jeweils an allen vier Ecken der Ober- und Unterseite (431 a; 431 b) ausgebildet ist.

3. Organische elektrolumineszente Anzeigevorrichtung nach Alternative (i) von Anspruch 1, wobei die obere Elektrode (333) als Kathodenelektrode fungiert und die untere Elektrode (331; 431) als Anodenelektrode fungiert.

4. Verfahren zur Herstellung einer organischen elektrolumineszenten Anzeigevorrichtung, wobei das Verfahren die folgenden Schritte aufweist:

Ausbildung eines Dünnfilmtransistors, der eine Source-/Drain-Elektrode (315, 316) aufweist, in einer Nichtemissionsregion (310) auf einem Isoliersubstrat (300);
Ausbildung einer unteren Elektrode (331) in einer Emissionsregion (330) auf dem Isoliersubstrat (300) derart, dass sie über ein Kontaktloch (317) mit einer Elektrode der Source-/Drain-Elekrode (315, 316) verbunden ist, wobei die untere Elektrode abgerundete Ecken aufweist,
Ausbildung einer organischen Emissionsschicht (332) in der Emissionsregion (330) auf der unteren Elektrode (331); und

Ausbildung einer oberen Elektrode auf der organischen Emissionsschicht (332),
dadurch gekennzeichnet, dass

(i) die untere Elektrode (331) eine Oberseite (331 a) aufweist, bei der ein Mittelpunkt des Radius der Krümmung (p31) an ihren Ecken ist, sodass der Radius der Krümmung (p31) Null beträgt, und eine Unterseite (331b) aufweist, deren Ecken eine Krümmung aufweisen und bei der ein Mittelpunkt des Radius jeder Krümmung (p32) auf einem Punkt auf der selben Achse liegt wie eine Achse, auf der ein Mittelpunkt des Radius der Krümmung (p31) der Oberseite positioniert ist, wobei die Achse perpendikulär zu einer Ebene ist, auf der der Mittelpunkt des Radius jeder Krümmung (p31) der Oberseite positioniert ist, sodass der Radius jeder Krümmung (p32) der Unterseite (331 b) größer als Null ist, oder
(ii) die untere Elektrode (431) eine Oberseite (431a), deren Ecken eine Krümmung aufweisen, deren Mittelpunkt auf der Oberseite (431a) positioniert ist, und eine Unterseite (431 b) aufweist, deren Ekken eine Krümmung aufweisen und bei der ein Mittelpunkt des Radius jeder Krümmung (p42) auf einem Punkt auf der selben Achse liegt wie eine Achse, auf der ein Mittelpunkt des Radius der Krümmung (p41) der Oberseite (431a) positioniert ist, wobei die Achse perpendikulär zu einer Ebene ist, die der Mittelpunkt des Radius jeder Krümmung (p41) der Oberseite (431a) aufweist, wobei der Radius jeder Krümmung (p42) der Unterseite (431b) größer als derjenige der Oberseite (431 a) ist.

5. Verfahren nach Anspruch 4, wobei die Ober- und die Unterseite (331a; 331b; 431a; 431 b) der unteren Elektrode (331, 431) vier Ecken aufweist und wobei gemäß Alternative (i) die Krümmung jeweils an allen vier Ecken der Unterseite (331 b) ausgebildet ist, und wobei gemäß Alternative (ii) die Krümmung jeweils an allen vier Ecken der Ober- und Unterseite (431 a; 431 b) ausgebildet ist.

Revendications

1. Dispositif d'affichage électroluminescent organique, comprenant :

un transistor à couches minces formé dans une région (310) de non-émission sur un substrat isolant (300) et ayant des électrodes (315, 316) de source et de drain ;
une électrode inférieure (331) formée dans une région (330) d'émission sur le substrat isolant (300) et connectée à une électrode des électrodes (315, 316) de source et de drain à travers un trou de contact (371) ;
une couche organique (332) d'émission formée dans la région (330) d'émission sur l'électrode inférieure (331) ; et
une électrode supérieure (333) formée sur la couche organique (332) d'émission,
dans lequel l'électrode inférieure (331) a une surface dont les coins sont arrondis,
caractérisé :

(i) **en ce que** l'électrode inférieure (331) a une surface supérieure (331a) dans laquelle le centre de rayon de courbure (31) est au niveau de ses coins de sorte que le rayon de courbure (31) est nul, et une surface inférieure (331b) dont les coins ont une courbure dans laquelle le centre de rayon de chaque courbure (32) est à un point sur le même axe que l'axe sur lequel est placé le centre de rayon de courbure (31) de la surface supérieure, dans lequel l'axe est perpendiculaire à un plan sur lequel est placé le centre de rayon de chaque courbure (31) de la surface supérieure de sorte que le rayon de chaque courbure (32) de la surface inférieure (331 b) est plus grand que zéro, ou bien
(ii) **en ce que** l'électrode inférieure (431) a une surface supérieure (431a) dont les coins ont une courbure dont le centre est placé sur la surface supérieure (431a), et une surface inférieure (431 b) dont les coins ont une courbure dans laquelle le centre de rayon de chaque courbure (42) est à un point sur le même axe que l'axe sur lequel est placé le centre de rayon de courbure (41) de la surface supérieure (431a), dans lequel l'axe est perpendiculaire à un plan incluant le centre du rayon de chaque courbure (41) de la surface supérieure (431a), dans lequel le rayon de chaque courbure (42) de la surface inférieure (431 b) est plus grand que celui de la surface supérieure (431 a).

2. Dispositif d'affichage électroluminescent organique selon la revendication 1, dans lequel la surface supérieure et la surface inférieure (331 a ; 331 b ; 431 a ; 431 b) de l'électrode inférieure (331, 431) ont quatre coins et dans lequel, dans une variante (i), une courbure est formée aux quatre coins de la surface inférieure (331 b), respectivement, et dans lequel, dans une variante (ii), une courbure est formée aux quatre coins des surfaces supérieure et inférieure

(431a ; 431 b), respectivement.

3. Dispositif d'affichage électroluminescent organique selon la variante (i) de la revendication 1, dans lequel l'électrode supérieure (333) sert d'électrode de cathode et l'électrode inférieure (331 ; 431) sert d'électrode d'anode.

4. Procédé de fabrication d'un dispositif d'affichage électroluminescent organique, le procédé comprenant les étapes :

de formation d'un transistor à couches minces ayant des électrodes (315, 316) de source et de drain dans une région (310) de non-émission sur un substrat isolant (300) ;
de formation d'une électrode inférieure (331) dans une région (330) d'émission sur le substrat isolant (300) pour être connectée à une électrode des électrodes (315, 316) de source et de drain à travers un trou de contact (371), l'électrode inférieure ayant des coins arrondis ;
de formation d'une couche organique (332) d'émission dans la région (330) d'émission sur l'électrode inférieure (331) ; et
de formation d'une électrode supérieure sur la couche organique (332) d'émission,
caractérisé :

(i) **en ce que** l'électrode inférieure (331) a une surface supérieure (331a) dans laquelle le centre de rayon de courbure (31) est au niveau de ses coins de sorte que le rayon de courbure (31) est nul, et une surface inférieure (331b) dont les coins ont une courbure dans laquelle le centre de rayon de chaque courbure (32) est à un point sur le même axe que l'axe sur lequel est placé le centre de rayon de courbure (31) de la surface supérieure, dans lequel l'axe est perpendiculaire à un plan sur lequel est placé le centre de rayon de chaque courbure (31) de la surface supérieure de sorte que le rayon de chaque courbure (32) de la surface inférieure (331 b) est plus grand que zéro, ou bien
(ii) **en ce que** l'électrode inférieure (431) a une surface supérieure (431a) dont les coins ont une courbure dont le centre est placé sur la surface supérieure (431a), et une surface inférieure (431 b) dont les coins ont une courbure dans laquelle le centre de rayon de chaque courbure (42) est à un point sur le même axe que l'axe sur lequel est placé le centre de rayon de courbure (41) de la surface supérieure (431a), dans lequel l'axe est perpendiculaire à un plan incluant le centre du rayon de chaque courbure (41) de la surface supérieure (431a), dans lequel le rayon de chaque courbure (42) de la surface inférieure (431 b) est plus grand que celui de la surface supérieure (431 a).

5. Procédé selon la revendication 4, dans lequel la surface supérieure et la surface inférieure (331a ; 331b ; 431a ; 431b) de l'électrode inférieure (331, 431) ont quatre coins et dans lequel, dans une variante (i), une courbure est formée aux quatre coins de la surface inférieure (331b), respectivement, et dans lequel, dans une variante (ii), une courbure est formée aux quatre coins des surfaces supérieure et inférieure (431a ; 431 b), respectivement.

FIG. 1A

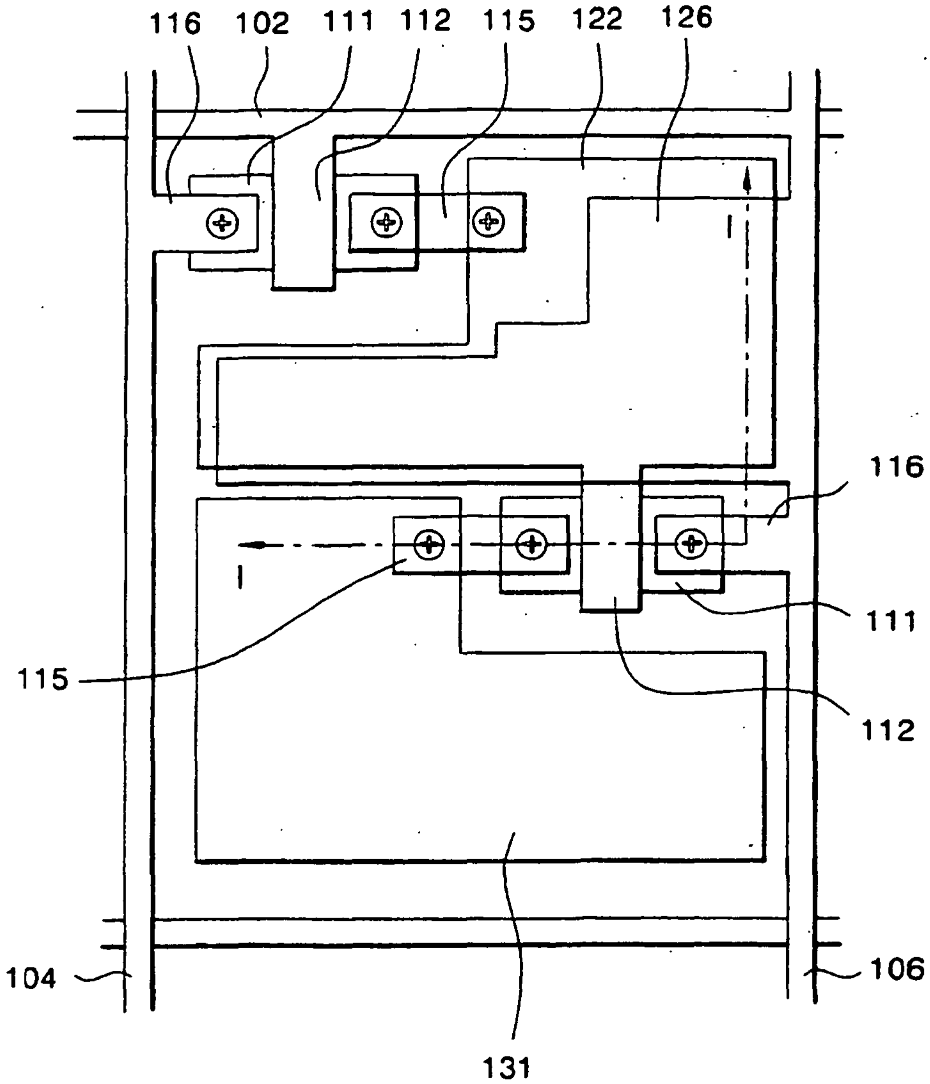

FIG. 1B

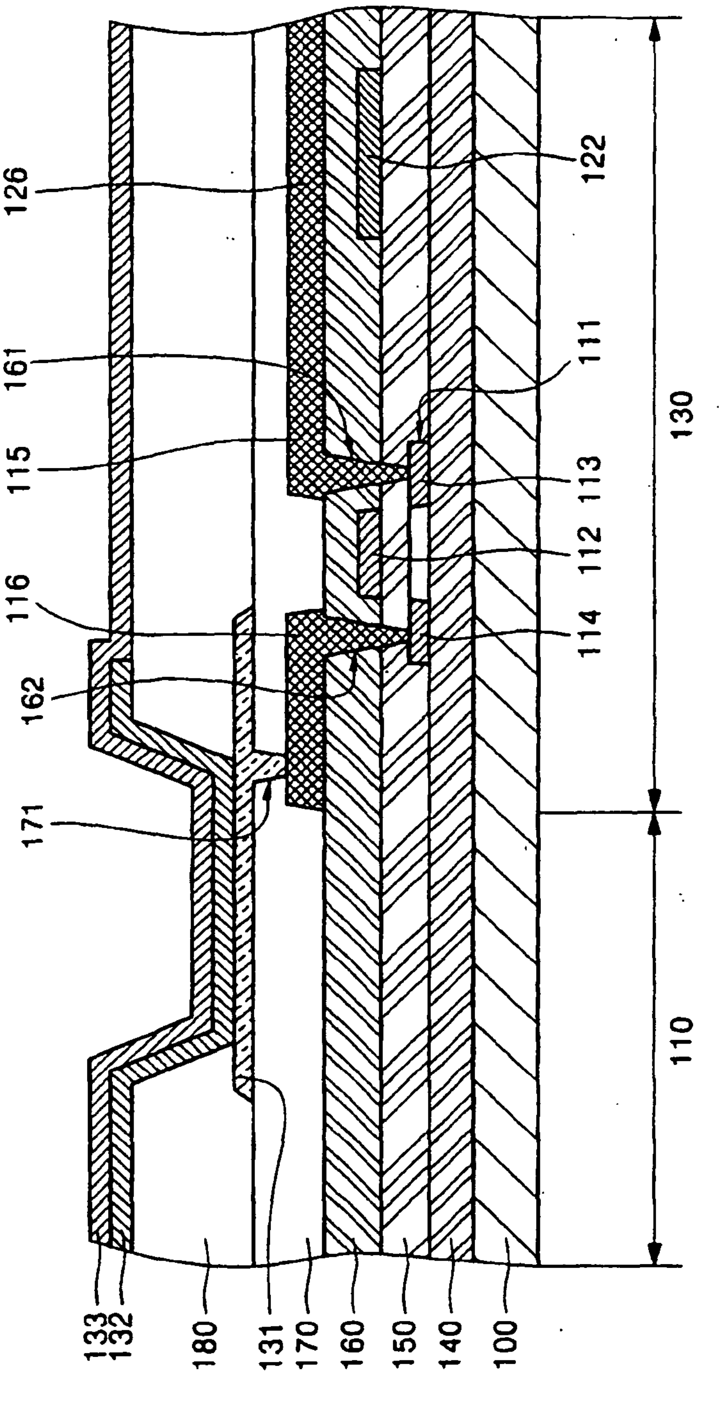
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FIG. 2A

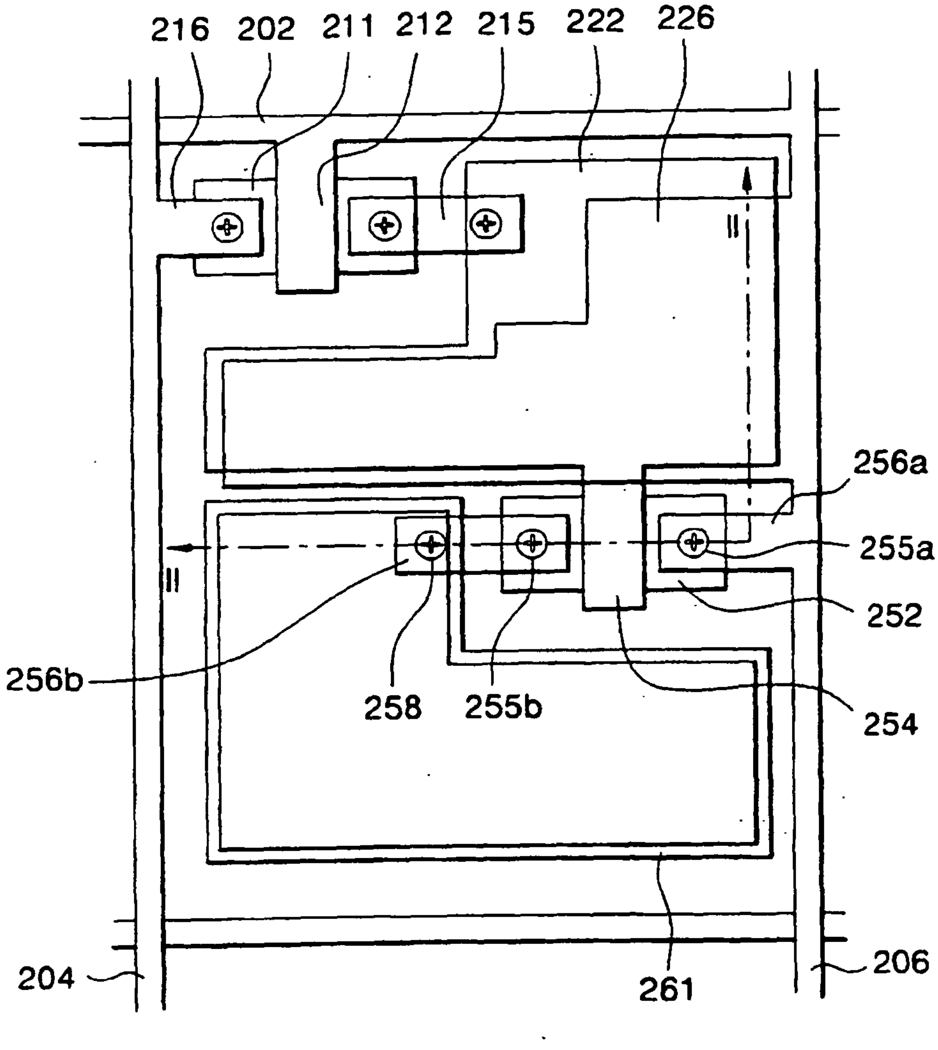
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FIG. 2B

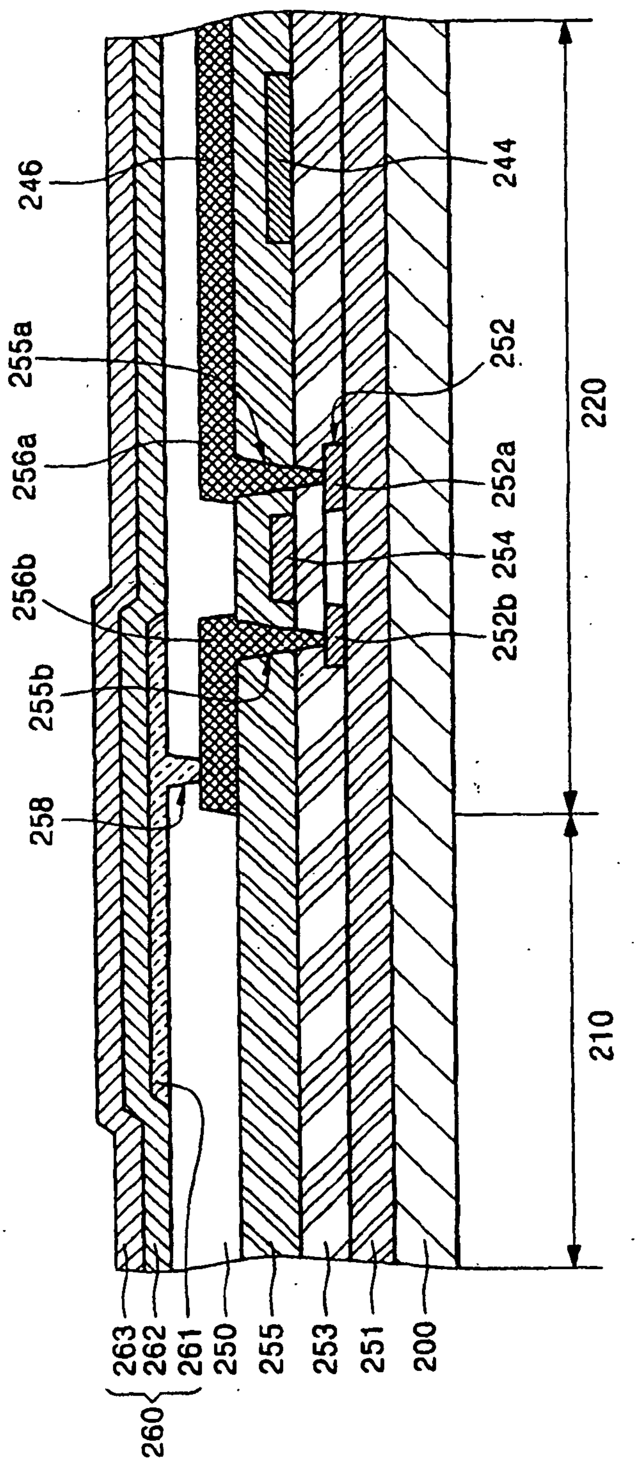
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FIG. 2C

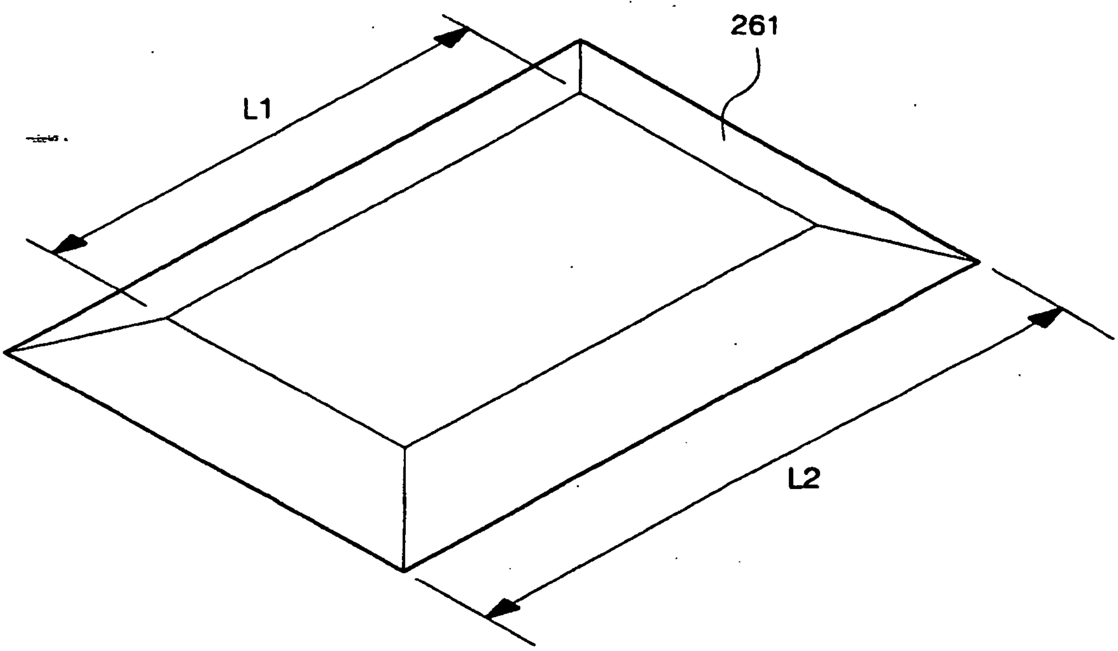


FIG. 2D

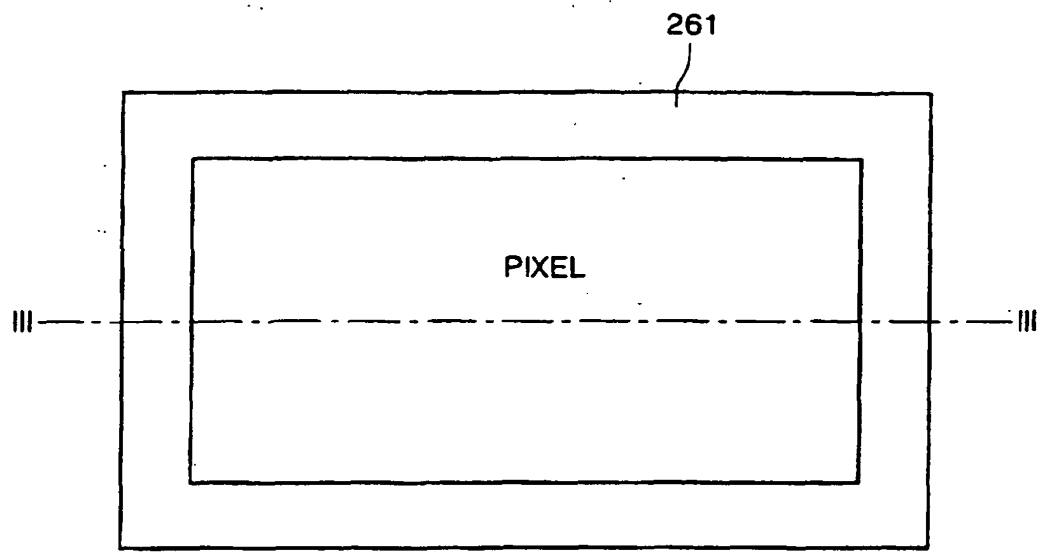


FIG. 2E

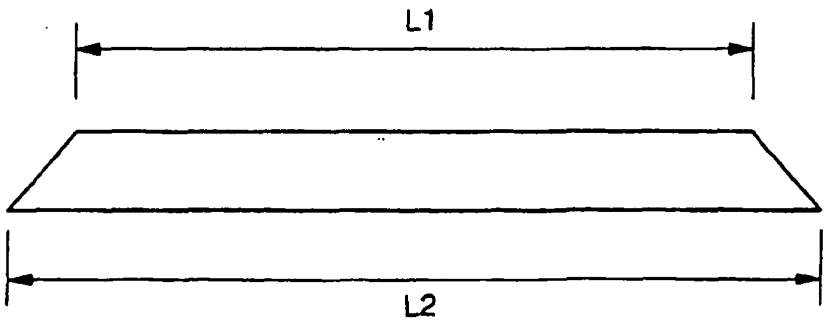


FIG. 2F

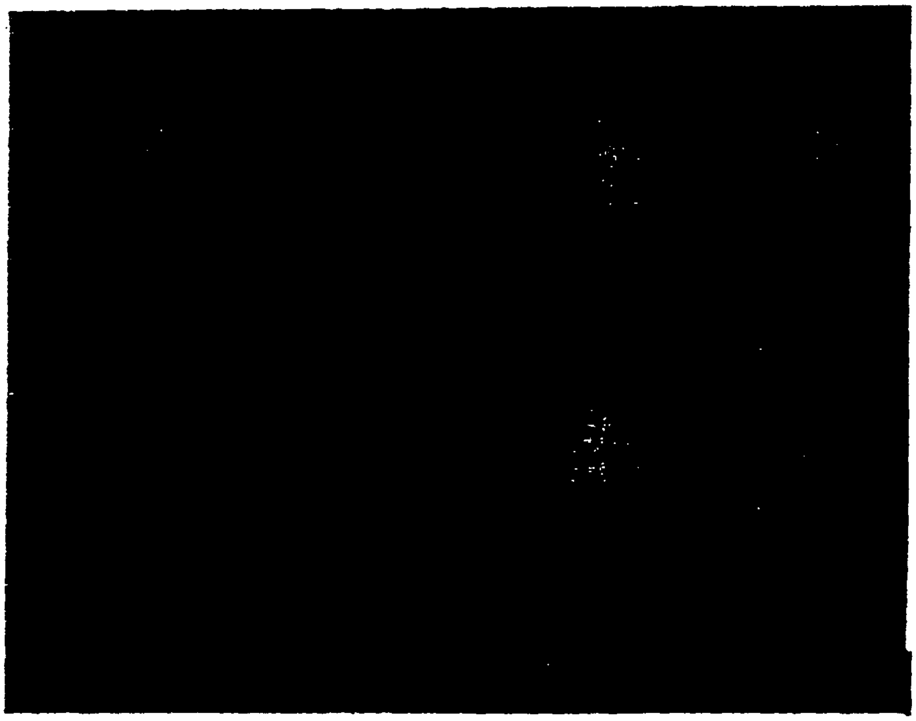
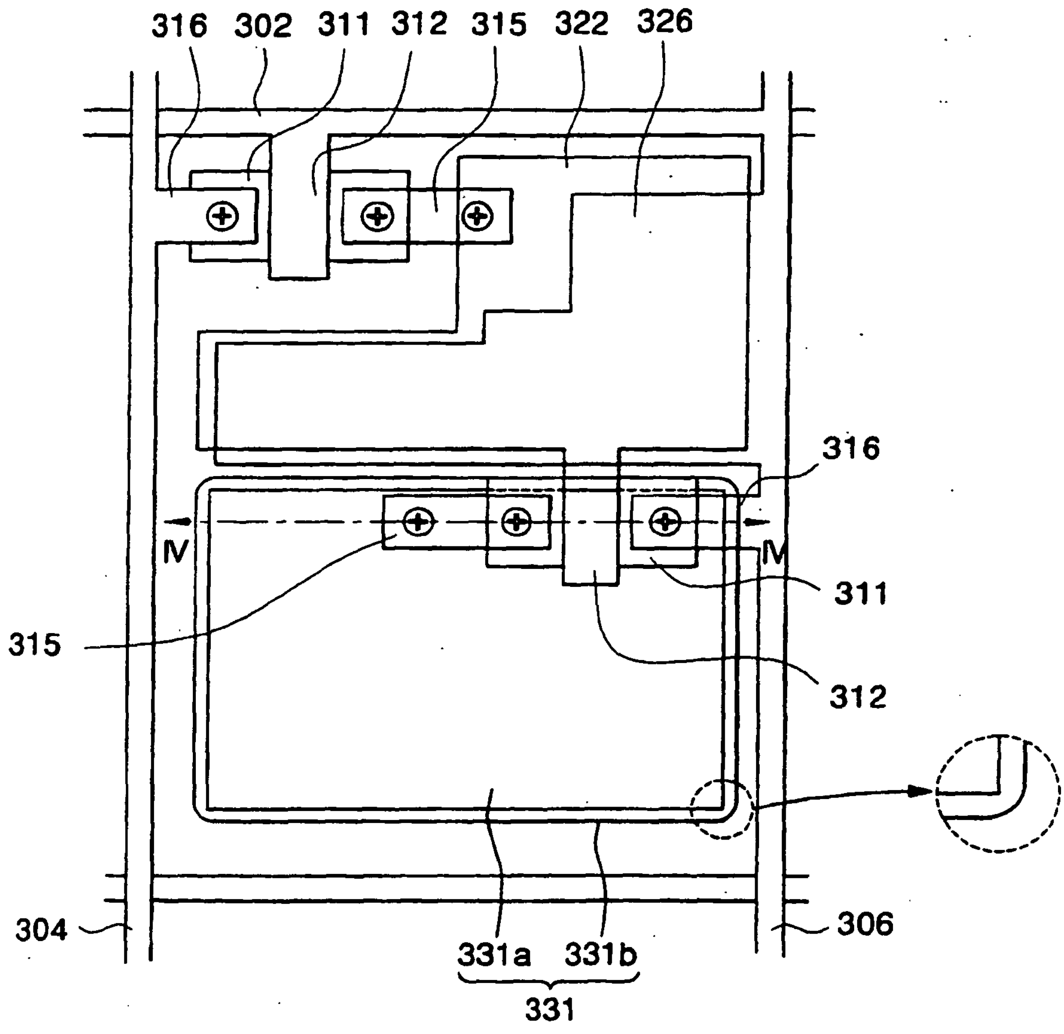


FIG. 3A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331a
331b
331

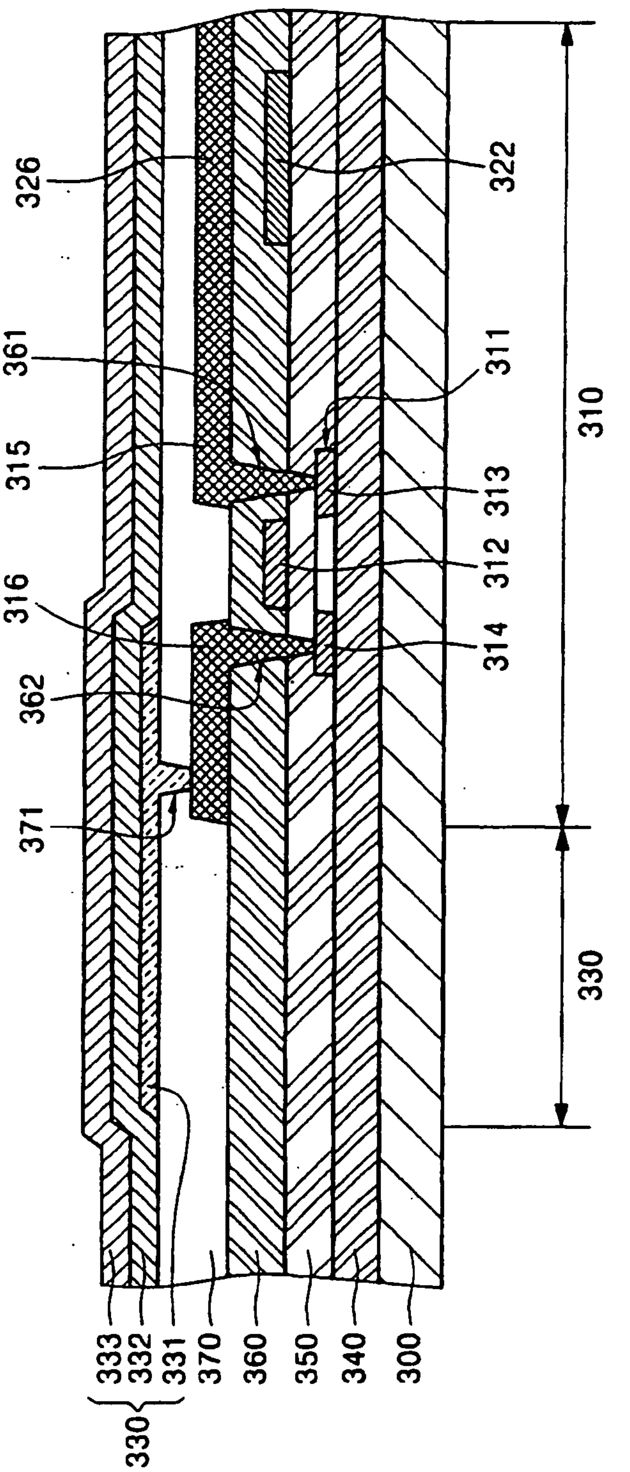
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FIG. 3B

FIG. 3C

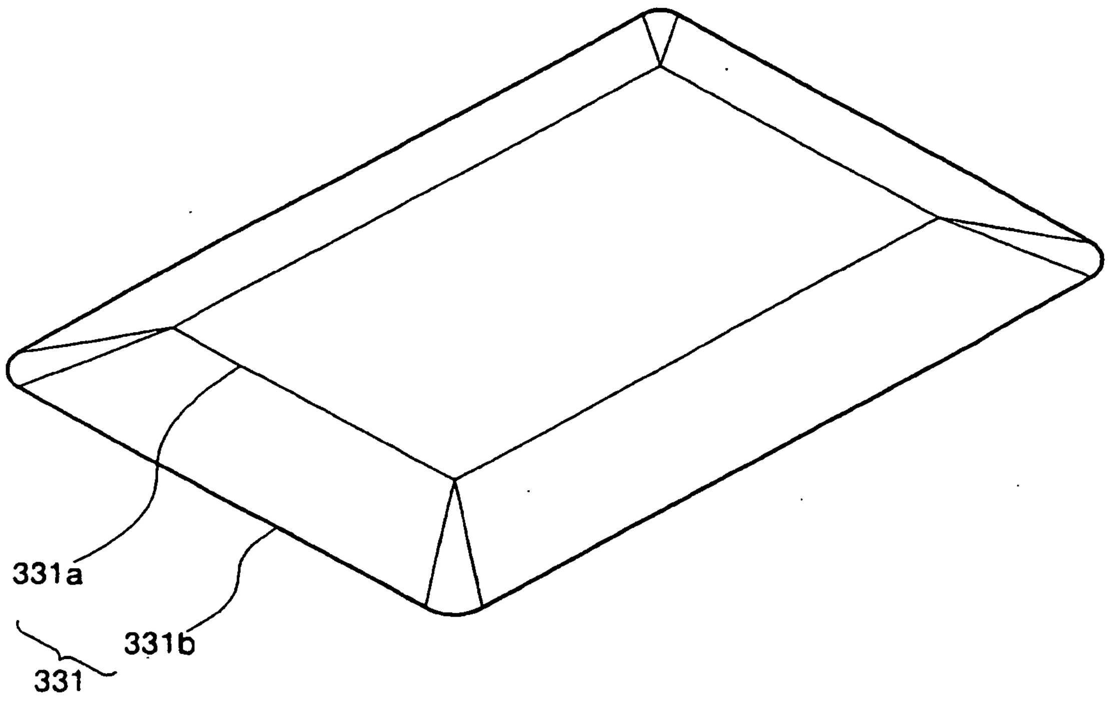

FIG. 3D

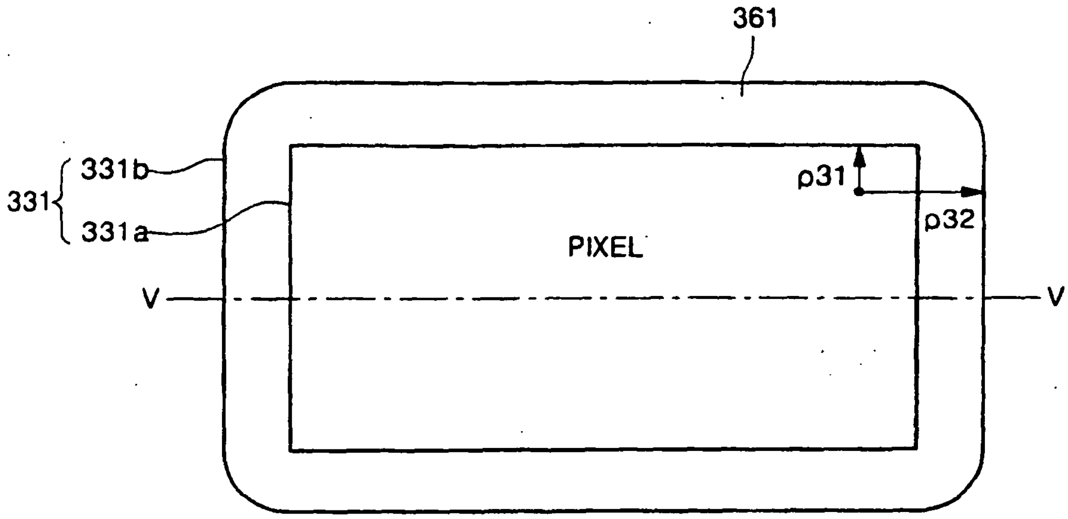

FIG. 3E

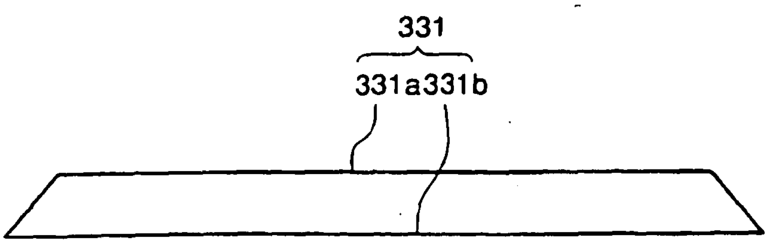

FIG. 4A

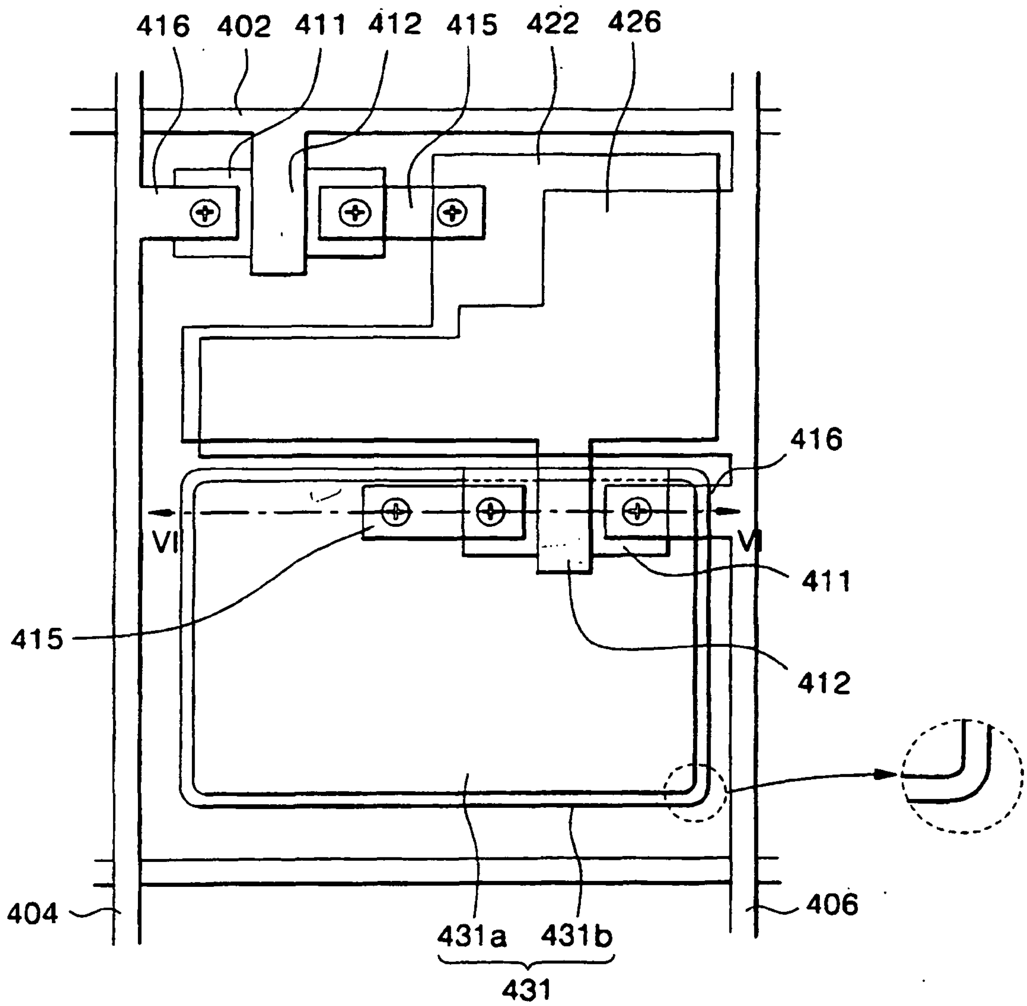
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FIG. 4B

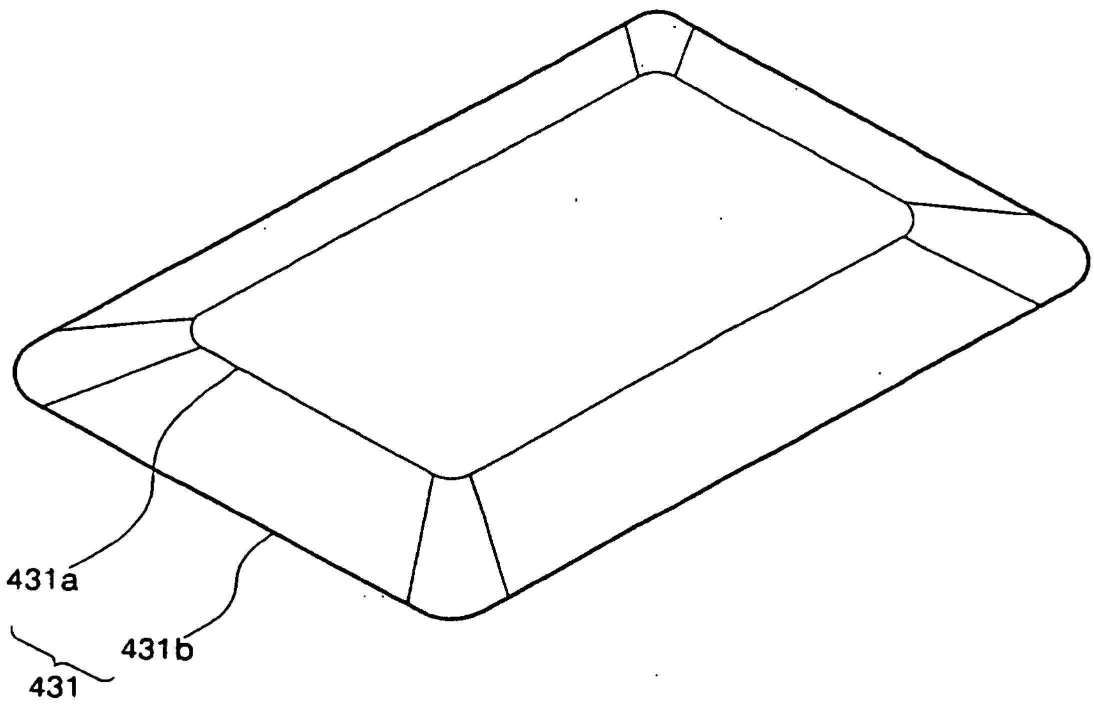


FIG. 4C

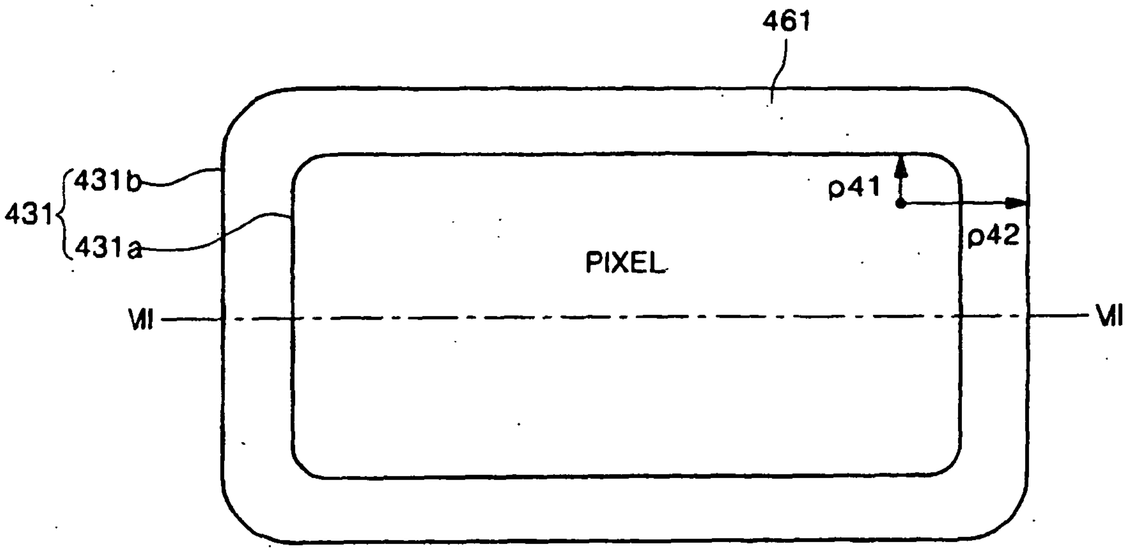
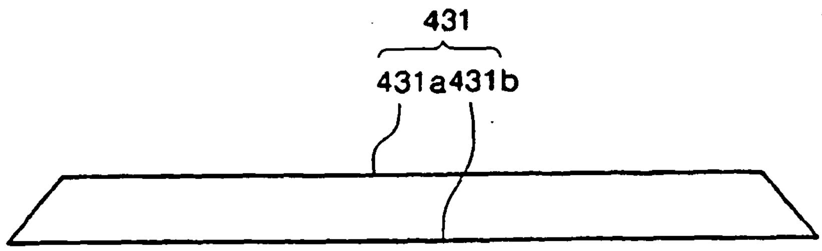


FIG. 4D



REFERENCES CITED IN THE DESCRIPTION

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- EP 1333497 A2 **[0021]**
- JP 3105893 A **[0021]**
- US 2003203527 A1 **[0021]**
- JP 2001110575 A **[0021]**

专利名称(译)	有机电致发光显示装置及其制造方法		
公开(公告)号	EP1536473B1	公开(公告)日	2012-06-06
申请号	EP2004090474	申请日	2004-11-29
[标]申请(专利权)人(译)	三星斯笛爱股份有限公司		
申请(专利权)人(译)	三星SDI CO.，LTD.		
当前申请(专利权)人(译)	三星移动显示器有限公司.		
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IPC分类号	H01L27/32 H01L51/52 H05B33/26 H01L51/50 H05B33/10		
CPC分类号	H01L27/3244 H01L51/5209		
代理机构(译)	hengelhaupt，Jürgen		
优先权	1020030086154 2003-11-29 KR		
其他公开文献	EP1536473A1		
外部链接	Espacenet		

摘要(译)

本发明涉及一种改进的有机电致发光器件。在一个实施例中，OLED包括在还包括源电极和漏电极的绝缘基板上的非发射区域中形成的薄膜晶体管。 OLED还包括形成在绝缘基板上的发射区中并通过接触孔连接到源/漏电极的一个电极的下电极。 OLED还包括形成在下电极上的发射区域中的有机发射层和形成在有机发射层上的上电极，其中下电极具有圆角的表面。下电极用作像素电极。使其具有圆角的表面防止短期引起的缺陷。

FIG. 1A